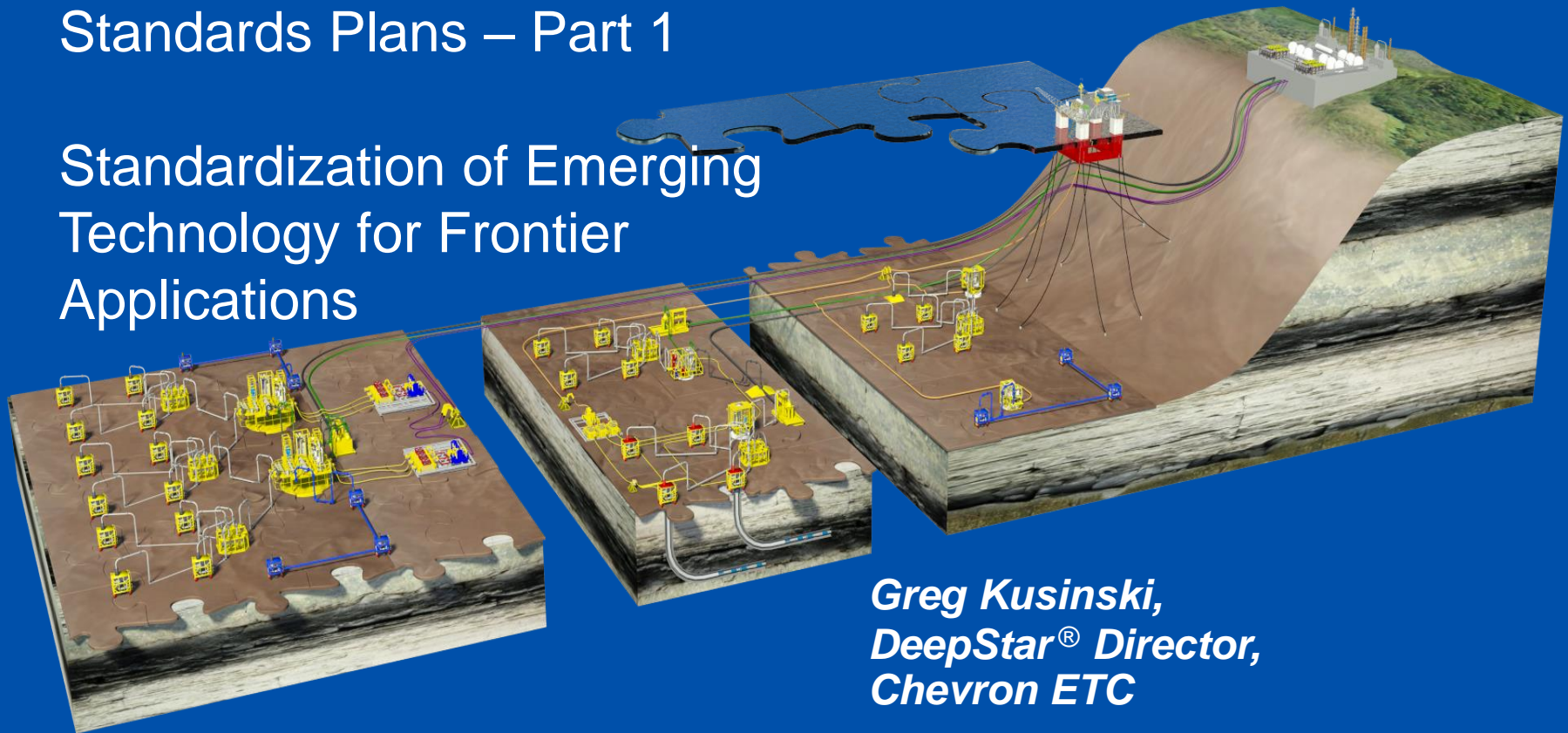


DEEPSTAR®

A Global Deepwater R&D Consortium

Standards Plans – Part 1

Standardization of Emerging
Technology for Frontier
Applications



Greg Kusinski,
DeepStar® Director,
Chevron ETC

Safety Moment

Attitudes and Behaviors



Humans instinctively seek to avoid pain and death. And yet, we may behave in a manner that is a threat to our well-being. There are a couple of reasons why this occurs:

1. Lack of **knowledge**; What you do not know, can hurt you!
2. The second reason we may act in a risky manner is **attitude**.

What is your attitude toward safety?

- Remember, **attitude affects behavior**. If you have a positive attitude, odds are you will exhibit safe behavior. A negative attitude toward safety will only cause conflict, stress and, ultimately, an accident.



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Participant Members:



Flora Yiu,
Marine Technology
Manager



John Vicic,
Manager Deepwater Facilities
Technology



Greg Kusinski,
DeepStar Director and
Senior Advisor to DeepStar



Dan Smallwood,
Manager Technology
Development,
Artic & Deepwater



Steve Brown,
Lead Facilities Engineer



Gail Baxter,
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Keith Henderson, VP,
Development & Production



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Engineering & Technology



Cesar Lima, Subsea Equipment
Engineer.
Luiz Souza, Production Engineering
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Technology Manager
Randy Bush, Principal Facilities
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DeepStar®

22 Years of Deepwater R&D Excellence



Since 1991, DeepStar® is an operator funded Research & Development collaboration Program between oil companies, vendors, regulators and academic/research institutions. **Our Goals:**


- **Improve the Profitability of Deepwater Production** through improvements in execution, operability, flexibility and **reliability** of existing deepwater systems;
- **Develop New Technology** to enable production in areas that are currently technically unproven with the specific ultimate goal of developing the technology required for economic production in water depths up to 12,000 feet (i.e., develop enabling technology);
- Act in a **Facilitator** role, providing a **Forum** and a process for **Discussion**, guidance, and feedback with operators, contractors, vendors, regulators, and academia regarding deepwater production systems (Gaps, Technology Roadmaps, Technology Development, Standardization, etc.)
- Work to ensure the **Acceptance of Deepwater Technology** by:
 - (a) facilitating the development of industry standards & practices,
 - (b) fostering communications with regulatory bodies.



Standards and Technology Maturation



- 
- **Conceptual Designs**
 - API 17N Subsea Reliability
 - 11904 – Qualification of Subsea Processing Systems
 - **Initial Deployments**
 - API 17 H ROV Standards
 - 11304 – AUV Interfaces and Standardization
 - **Increased Field Experience, (Standard Improvements)**
 - API RP 17O – RP for HIPPS
 - 11206 – Coupled Reservoir and Wellbore Analysis for HIPPS Design
 - **Fit for Continued Operation (Integrity Management Recommended Practices)**
 - Sampling of Monitoring and Inspection Studies
 - 11405 – Mooring Integrity Management



TDS	Name
1	Initiation
2	Concept
3	Proof of Concept
4	Integration
5	Demonstration
6	Prototype
7	Pre-production
8	Production
9	Field Proven

Conceptual Design Standards



- A *PROCESS* whereby a frontier technology is qualified for design and field use.
 - What qualification procedures and parts of applicable standards should be applied?
 - Typically, all risks with major consequences are identified and the qualification process works to mitigate these risks.
 - Example: DeepStar® 7301 – Now API 17N – Subsea Production System Reliability and Technical Risk Management (8 years ago)

DeepStar® 11904 – Frontier Technology System Integrity Management – Current Project



- The project identifies the risks and their mitigation, establishing the shortcomings of existing standards and guidelines when it comes to **qualification of new subsea process technologies**. It will then propose a RP for the qualification of such technologies from the point of view of integrity management.
- The objective is to develop better clarity on the subsea process system evaluation and qualification.
- Further, this systematic approach to new technology is critical as reliability targets are becoming stricter with greater demand on focused evaluation and qualification requirements.
- The Project Schedule runs till September 2014



Photo Courtesy of FMC Technologies; A DeepStar Member

Initial Deployment Standards

Early DeepStar Examples



- ROV Interface and Capability Studies (01260 & 01270) were initial DeepStar® work cataloguing ROV capabilities and expectations.
- This led to *API 17H “Remotely Operated Vehicle Interfaces on Subsea Production Systems”*
- API 17H was late in the ROV development and deployment cycle – consequently, there were various proprietary interface alternatives in the market place.



Initial Deployment Standards – Current Project



DeepStar® 11304 – “AUV Interface Standards & Regulatory Standards for AUV Inspections for Ultra Deepwater Fields” will pro-actively:

- 1) Identify inspection technologies which can be applied to achieve improved cost effectiveness
- 2) Develop proposed AUV inspection standards via industry workshops
- 3) Review proposed inspection methods and standards with BOEMRE / BSEE
- 4) Identify & work with industry standards groups (e.g. API) to get proposed stds adopted
- 5) Define the list of AUV interface parameters which should be standardized
- 6) Work with industry standards groups such as API, ASTM and ISO to get proposed AUV interface standards into the review, approval, and implementation process



Photo courtesy of Lockheed Inc; A DeepStar Member and Contractor

Increased Field Experience Standards



- HIPPs – DeepStar® 7306 held workshops and prepared a report on the required function and performance of HIPPs Systems.
- The work led into *API RP 170 – “Recommended Practice for Subsea High Integrity Pressure Protection Systems (HIPPS)”* first published in 2009.
- In 2011 DeepStar® 10304 extended the HIPPs work by defining the performance and requirements for an all-electric HIPPs control system.



Kristen Project
Hydraulic HIPPS
Valve

11206 – HIPPS Standard Improvement with Increased Experience



A HIPPS (High Integrity Pressure Protection System) will be an enabler for many subsea developments with high pressure wells. Paleogene reservoirs in the Gulf of Mexico (GOM) will require HIPPS and pose unique challenges for flow simulation modeling.

The coupled response of the near wellbore to the flowline system is a required improvement for an efficient and cost effective design of HIPPS.

The incentive is to develop and qualify methods for accurate HIPPS simulations for systems with Paleogene wells, or similar well behavior. Current 170 methods are too conservative and lead to:

- Faster than necessary short-duration HIPPS valve response times
- Longer than necessary fully rated sections upstream of HIPPS
- Longer than necessary reinforced sections downstream of HIPPS to protect against hydrate plug risk
- Inaccurate setting of HIPPS trigger pressure and MAOP of the flowline downstream of HIPPS
- Over estimation of the demand frequency of HIPPS closure events

Fit for Continued Operation (Integrity Management Recommended Practices)



- DeepStar® has many studies and reports for Inspection and Monitoring technologies that are intended to verify a system or component is fit for continued operation.
- This work has typically included:
 - function testing,
 - monitoring production,
 - monitoring corrosion and
 - monitoring for fatigue management.
- Current Integrity Management work includes mooring systems:

DeepStar 11405: Risk Based Mooring Integrity Management



“The industry’s mooring failures identify an area for improvement. DeepStar® is responding with mitigations and guidance plans.”

- **What was the issue?**

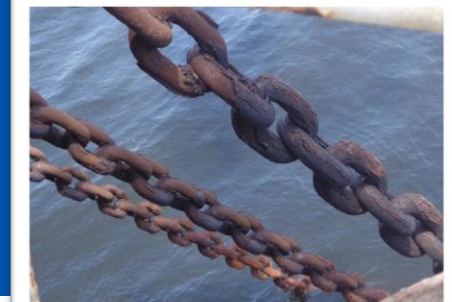
- The industry is having some mooring failures with more than 20 major incidents recorded in the past 10 years world-wide. *(Remember, mooring systems have some redundancy.)*

- **What are we doing?**

- DeepStar® funded a research project 11405 to develop a Risk-based Integrity Management guide.

- **What are we doing above and beyond?**

- DeepStar® is helping the industry by publishing the key findings. Also, DeepStar is considering to allow API to use these guidelines.



DeepStar® 11405: Risk Based Mooring Integrity Management



■ Key Findings:

- Annual rates of multiple line failure were found to be around of **3.5×10^{-3} per facility**. Clearly, there are opportunities for improvements in the application of mooring integrity practices.
- Half of all failure events were associated with **chain**, 2 thirds of which were fatigue or corrosion related.
- **Steel wire rope** accounted for another third of all failure events, with 40% of these events occurring during installation.
- Over half the failure events were associated with causes arising out of **design, construction / manufacturing and installation** phases.
- Mooring **integrity management program** needs to be properly formulated, as over 35 pre-emptive replacements have been performed in the past years.
- The illustrated OTC paper based on this work will be presented at OTC 2014.



OTC 25273

Industry Survey of Past Failures, Pre-emptive Replacements and Reported Degradations for Mooring Systems of Floating Production Units

E. Fontaine, A. Kilner, C. Carra, D. Washington, AMOG Consulting, K.T. Ma, Chevron ETC, A. Phadke, D. Laskowski, ConocoPhillips, G. Kusinski, DeepStar®, Chevron ETC.

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This paper was prepared for presentation at the Offshore Technology Conference held in Houston, Texas, USA, 5-8 May 2014.

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Abstract

The results of an industry survey of mooring line failures are presented and analyzed. The failure data presented includes geographic location, mooring line composition, prevalent failure modes and the phase of failure inception. At a component level, cause of failure, location along the line and time to failure are presented. Failure data suggests that the observed increase in the number of failures is proportional to the increase of the FPSO population, with the underlying failure rate per mooring line approximately constant over the last ten years.

Introduction

Projects Cover the Range



**High
Level
Concepts
&
Scenarios**



- In last 20 years over \$100MM
- Projects are business need driven
- Typical projects are stage-gated
- \$250K– \$1 MM, 12-24 months
- Low TRL, 1-5 (proof of concept)
- Single prime contractor per project (some with multiple subs)
- Follow-on work is often funded by others.

**Detailed
Focused
Projects**

Standards Maturation – Concluding Remarks



- 
- Conceptual Designs
 - Initial Deployments
 - Increased Field Experience
(Standard Improvements)
 - Fit for Continued Operation (Integrity
Management Recommended Practices)

Opportunities:

- Re-establish the X100 Scheduled Technical Meetings between DeepStar® & BSEE.
- For Frontier Technologies identify gaps in the codes that would impact permitting.
- We welcome your ideas and engagement.

